Association between Actual and Perceived U.S. COVID-19 Policies and Preventive Behavior

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Abstract

Background. COVID-19 related policies in the U.S. can be confusing: Some states, but not others, implemented mask mandates mid-pandemic, and states re-opened their economies to different levels with different timelines after initial shutdowns.

Purpose. The current research asks: How well does the public's perception of such policies align with actual policies, and how well do actual vs. perceived policies predict the public's mask-wearing and social distancing behaviors during the COVID-19 pandemic?

Methods. We conducted a pre-registered cross-sectional study among 1073 online participants who were representative of the U.S. population on age, gender, and education on Monday-Tuesday, July 20-21, 2020. We asked participants which locations they visited in the past weekend, and their mask-wearing and social distancing behaviors at each location. We also measured participants' beliefs about their state's policies on mask mandate and business opening and obtained objective measures of these policies from publicly available data.

Results. Perception about the existence of mask mandate was 91% accurate in states with a mask mandate, but only 46% accurate in states without one. Perception of state reopening level did not correlate with policy. It was the perceived, but not actual state mask mandate that positively predicted both mask-wearing and social distancing, controlling for state COVID-19 cases, demographic factors, and participants' numeracy and COVID-19 history.

Conclusions. The public's perception of state-level mask mandates erred on the side of assuming there is one. Perception of reopening is almost completely inaccurate. Paradoxically, public perception that a mask mandate exists predicts preventive behaviors better than actual mandates.

Keywords: COVID-19; Mask mandate; Mask-wearing; Policy; Policy perception

The COVID-19 pandemic is quickly becoming the worst global pandemic in the last 100 years [1]. Yet in the United States, COVID-19 related policies are not only often lacking, but those that are in place are frequently confusing. During the second wave of the COVID-19 pandemic in the summer of 2020, some states, but not others, implemented mask mandates mid-pandemic[2], and different states re-opened their economies to different levels with different timelines after initial shutdowns[3]. This raises the potential that the public may not have correct knowledge of state-level COVID-19 policies. Actual COVID-19 policies can influence the boundaries of individuals' behavior, such as whether one can go to a restaurant or gym. However, the responsibility to perform critical COVID-19 preventive behaviors, such as mask-wearing and social-distancing, depend largely on the public's own decisions. Because policy perception has a direct influence on behavior [4], perceptions of COVID-19 policies, either accurate or inaccurate, may have a strong impact on how the public behaves to protect themselves and others against the virus.

In the current paper, we ask: Do Americans know the mask mandate and business opening policies in their state? And do actual policies versus what the public believes to be the policies exert a stronger influence on mask-wearing and social distancing behaviors? We investigate these questions using survey and objective data collected in July 2020, during the second wave of the COVID-19 pandemic in the U.S.

Methods

We conducted a cross-sectional survey study among a sample of 1,073 participants that were representative of the U.S. population on age, gender, and education. The survey assessed participants mask-wearing and social-distancing behavior using recall for events in the previous 2-3 days, as well as participant perception of COVID-19 related policies in their state,

specifically mask mandates and business reopening. We also collected objective data on mask mandates and business reopening policies at the state level, as well as objective COVID-19 case data in each state during the time of the study.

Open Science Practice. We pre-registered the study at https://aspredicted.org/3h6qi.pdf. The original materials, data, and codebook are all posted publicly on https://osf.io/htzfj/.

Participants. We recruited participants for an online survey through Qualtrics Panel, the participant recruitment service of a commercial survey company. Qualtrics Panel posted the survey to the dashboard of panelists and recruited U.S. participants over age 18 that were representative of the U.S. population on age, gender, and education using quotas based on the U.S. Census data from 2015-2018[5-7], as follows: Male (49%), Female (51%); Age 18-34 (32%), 35-54 (37%), 55+ (31%); Education less than HS (15%), HS (30%), Some College (25%), College (20%), Post College: (10%).

Survey Administration. We conducted the survey study on Monday-Tuesday, July 20-21, 2020, and asked participants to recall their activities during the past weekend (July 18-19, 2020). We focused on weekend activities as they are more likely to vary and to include trips outside the home than weekday activities for many people, especially as many people were working from home during this phase of the pandemic. A total of 1,268 participants completed the survey, among whom 195 failed an attention check based on the criterion discussed in the Survey Questions section below and were screened out of the data analysis, leaving 1,073 participants in the data analysis.

Survey Questions. After basic demographic information used for recruitment quotas (age, gender, and education), participants indicated whether they visited each of 13 following places in the past weekend: Restaurants/bars (eat in), restaurant (pick up food), work place

(excluding your home office), seeing friends (indoors), seeing friends (outdoors), parks/beaches/other outdoor recreation, theaters/museums/other indoor recreation, gym, grocery store, going out for a walk, pharmacy, retail places, personal care places (salon/spa/tattoo/message), all with a "Yes" or "No" response. For any of the places to which they responded "Yes," participants indicated the extent to which they 1) wore a mask or face covering, and 2) kept 6-feet away from others on a 5-point scale while they were at each of those places, on a 5-point scale including the scale points 1 "never," 2 "occasionally," 3 "sometimes," 4 "most of the time," and 5 "as much as humanly possible" for both questions.

Next, participants were asked as of this past weekend, whether they "know anyone in their life who has had COVID-19?" ("Yes" or "No") and "have you had COVID-19?" with three answer options ("Yes, I currently have COVID-19," "Yes, I have had COVID-19 before. But I'm no longer contagious," or "No, I've never had COVID-19.") In our analysis, we combined participants with current COVID-19 (n = 18, 1.7%) and prior COVID-19 (n = 25, 2.3%) into the same category due to the small number of participants in each.

We next asked perceived state policies on mask mandates and business reopening policies in the state where participants resided during the past weekend. We focused on state instead of county level policies for two reasons. First, participants' weekend actives such as visits to friends or outdoor recreation are likely to span across county borders, whereas movement across state lines is likely to be much less common. Second, objective up-to-date records on county-level COVID-19 policies are difficult to obtain, making the comparison between perceived and actual policies unfeasible. Participants indicated the extent to which they believed each of 8 business categories were open in their state: "Food & drink," "Personal care," "Outdoor recreation," "Indoor recreation," "Places of worship," "Retail stores & malls,"

"Childcare places," and "Other non-essential businesses" (5-point scale from 1 "all closed" to 5 "all open"). See the Electronic Supplementary materials for original wording and a brief explanation for each category. Participants also indicated their belief as to whether there was a mandate for wearing masks/face coverings in public in their state ("Yes" or "No").

Subsequently, we assessed participants' perceptions of the effectiveness of mask-wearing and social distancing, respectively, by asking their agreement with two statements "Masks/face coverings are effective at reducing COVID-19 transmission," and "Social distancing is effective at reducing COVID-19 transmission," on a 5-point scale from 1 "strongly disagree" to 5 "strongly agree." These measures were not included in the analysis due to the conceptual proximity between these effectiveness beliefs and mask wearing and social distancing behaviors.

Finally, we measured participants' numeracy skills because such skills may influence how people understand COVID-19 related risk information conveyed by authorities and therefore, their preventive behaviors. We used the Subjective Numeracy scale, a validated scale that previous research has shown to correlate highly with objective measures of numeracy (r = 0.62-0.68) but that imposes less burden on participants[8]. The scale included 8 questions such as "How often do you find numerical information to be useful?" and "When reading the newspaper, how helpful do you find tables and graphs that are parts of a story?" An overall numeracy score was computed as the mean across the 8 subjective numeracy questions after appropriate reverse coding for specific items.

At the end of the survey, we asked additional demographic questions: race/ethnicity, household income level (9 levels) and political orientation (5-point scale from 1 "conservative" to 5 "liberal"). We also included a simple attention check question, where we described a scenario "Alex goes shopping" and listed the 4 items purchased including "a clarinet that costs

$229.00," and asked "What musical instrument does Alex buy?" We included participants who responded with a correct answer (any spelling variant of "clarinet") in the analysis.

Objective Policy and Cases Data. We obtained objective measures of state-level COVID-19 mask-mandate policy, business opening policy, total COVID-19 cases per capita, and daily cases per capita all from publicly available sources.

State-level mask mandate data were obtained from the July 17, 2020 copy of a CNN rolling update on state mask mandates [2], and recorded as either "Yes" or "No" on having a state mask mandate. Note that July 17, 2020 was the Friday before participants' weekend outings and associated COVID-19 preventive behaviors that we asked them to report in the survey.

State business reopening data were obtained from the July 17, 2020 copy of a New York Times rolling update, which was based on data from state health departments across the U.S. [3]. Note that these data reflect business reopening per state policy provisions, and do not account for businesses that may violate such policies. The New York Times list included 58 kinds of businesses under 7 general categories: "Food and Drink," "Retail," "Outdoor and Recreation," "Industries," "Entertainment," and "Houses of worship." Details for each category is listed in the Electronic Supplementary Materials. These 7 general categories of businesses aligned fairly well with the 8 types of businesses we included in our survey, except that these objective reopening data did not include childcare facilities.

We retrieved the state-level total COVID-19 case data from the July 18, 2020 update on WorldOMeter [9], which compiles data around the clock from official websites of Ministries of Health and other government institutions and government authorities' social media accounts, and provides data to various agencies such as the UK government and John's Hopkins University's COVID-19 tracking site. We retrieved state-level average daily COVID-19 cases during the

week before the study using the July 22, 2020 version of the NPR rolling update, [10] which was based on data sources at the Center for Systems Science and Engineering at Johns Hopkins University[11]. We then computed state-level Total Cases/1 Million population and Daily Cases/1 Million population by dividing daily cases with the 2019 estimated state population from the United States Census Bureau [12].

Results

Accuracy in mask policy perception. Of the 1,073 participants, 797 (74%) correctly identified the status of mask mandate policy in their state: 616 (90.9%) of the 679 participants in states with mask mandates thought there was a mandate, but only 181 (45.8%) of the 395 participants in states with no mask mandate thought there was no mandate, suggesting that the error in mask-mandate perception resides mostly in states that do not have a mask mandate. Statistically, perceived and actual mask mandate policy had a moderate correlation, $r_\phi = .42$, $p < .001$.

Accuracy in business opening policy perception. We computed perceived business opening as the mean perceived business opening rating across the 8 categories of businesses in the survey. We computed objective business opening by counting the percentage of business types that were open in each of the 7 general business categories from the objective policy data from New York Times [3], and then taking the mean across the 7 general categories. Although not a perfect measure, this is the closest objective business opening data we could find in publicly available data. Perceived business reopening was not correlated with actual state business reopening policies, $r = -.05$, $p = .10$.

Mask-wearing and social distancing behaviors. Among 1,073 participants, 71 (6.6%) participants did not visit any of the public locations we listed in the survey, and therefore, did not

answer questions about mask-wearing and social distancing in public. Among the remaining 1,002 participants, we computed overall mask-wearing behavior and overall social-distancing behavior as the mean of self-reported levels of these behaviors across all the locations that participants reported visiting during the past weekend. Self-reported mask-wearing behavior had a mean of 3.72 (SD = 1.23), between 3 "sometimes" and 4 "most of the time" on the response scale. Distribution of mean mask wearing scores is as follows (all ranges include lower bound but not upper bound on the scale): 1 "never"-2 "occasionally" (10%), 2"occasionally" – 3 "sometimes"(13%), 3 "sometimes" - 4 "most of the time" (25%), 4 "most of the time"- 5 "as much as humanly possible" (21%), and exactly 5 "as much as humanly possible"(31%). Self-reported social-distancing behavior had a mean of 4.02 (SD = 1.05), just above 4 "most of the time." Distribution of mean social distancing score is: 1-2 (4%), 2-3 (13%), 3-4 (21%), 4-5 (26%), exactly 5 (36%). Thus, participants reported a relatively high level of mask-wearing and social distancing, with a negative skew in the distributions, and notably, about one third of participants reporting perfect mask-wearing or social distancing behavior.

Overall mask-wearing and social-distancing behaviors were positively correlated (r = .58, p < .001). In addition, mask-wearing and social distancing behaviors at each location also showed a significant positive correlation in all 13 locations listed in the survey (rs = .34 to .61, all ps <.001).

Predictors for mask-wearing and social-distancing behaviors. We conducted two multivariate hierarchical regressions on participants' mask-wearing and social-distancing behaviors, respectively. The outcome variables in the two regressions were overall extent of mask-wearing and social distancing, respectively. We did not transform the negatively skewed scores on mask-wearing and social distancing to preserve the interpretability of the results. The

two regressions used the same 3 sets of predictors, which were added in steps in 3 models. Model 1 predictors were: perceived state mask mandate, actual state mask-mandate policy, perceived state reopening level, actual state reopening level. Model 2 included 2 additional predictors: state total and daily new COVID-19 cases/1 million population. Model 3 added additional individual-level predictors: gender (1=female, 0 = male), age, education (1 = "completed some high school" to 7= "doctorate, law or professional degree"), political orientation (1 = "very conservative" to 5 = "very liberal"), household income (1 = "less than $20,000" to 9 = "$150,000+"), race/ethnicity (4 dummy codes for Hispanic, African American, Asian-pacific islander, and Native American or Multi-Racial, with Caucasian as the reference category), participant's numeracy score (mean of 8 items on the scale, Cronbach's $\alpha = .84$ across items), whether the participant knew someone who had COVID-19, and whether the participant had COVID-19 (currently or previously). Due to space limitations, we present results from Model 3, which included all predictors in this paper (Table 2) but results from Models 1 and 2 are presented in the Electronic Supplementary Materials Table S1 and Table S2.

Note that in this dataset, individuals are nested within states, so individual responses could be more related to each other within states than between states, resulting in clustering. We tested this clustering effect, but found a very small proportion of total variance to be between states, ICC = 0.05 for mask-wearing, ICC = 0.02 for social distancing. We also attempted a Multi-Level Modeling (MLM) analysis for mask-wearing and social distancing, respectively, using the same predictors as the regression analysis. The HLM model for mask-wearing showed near zero variance for the intercept across states and the final Hessian matrix to be not positive definite, suggesting that there is no sufficient variance between states to fit an MLM model. The MLM model for social-distancing showed similar results for the fixed effects of predictors as

Model 3 of the hierarchical regression. For simplicity, we report results from the regression models where all predictors are treated as predictors at the individual level.

As shown in Table 1, it was the perceived, but not actual state mask mandate that positively predicted mask-wearing behavior, B = 0.330, 95% *CI* [0.134, 0.526], *semi-partial* η^2 =.010, p = .001. Note that in zero-order correlations, actual mask mandate policy did correlate with mask-wearing, r = .11, p = .001. The same pattern also emerged with social-distancing as the outcome variable: It was the perceived, but not actual mask-mandate policy that predicted social-distancing behavior, B = 0.194, 95% *CI* [0.027, 0.361], *semi-partial* η^2 =.005, p = .023. In zero-order correlations, actual mask mandate policy did not correlate with social-distancing, r = -.003, p = .919.

The influence of state-reopening policy was a mixed story: In the two regressions, perceived state reopening level predicted social-distancing, B = 0.078, 95% *CI* [0.0004, 0.156], *semi-partial* η^2 =.003, p = .049, whereas actual state reopening level predicted mask wearing, B = 1.341, 95% *CI* [0.356, 2.327], *semi-partial* η^2 =.006, p = .008 (Table 1).

Effect sizes across all predictors shows that, for mask-wearing behavior, the biggest predictors are being more liberal (*semi-partial* η^2 =.038) and older age (*semi-partial* η^2 =.018), followed by higher total cases/1 Million population (*semi-partial* η^2 =.010), and perceived mask mandate (*semi-partial* η^2 =.010). For social-distancing, the biggest predictors are older age (*semi-partial* η^2 =.064), and being more liberal (*semi-partial* η^2 =.023), followed by numeracy (*semi-partial* η^2 =.014).

In exploratory analyses, we also tested the interaction between perceived and actual mask-mandate in addition to the above predictors in regressions for mask-wearing and social

distancing, but found no significant interaction, $p = .849$, *semi-partial* $\eta^2 < .0001$ for mask wearing and $p = .731$, *semi-partial* $\eta^2 < .0001$ for social distancing.

Discussion

The current study used recall of the past 2-3 days to assess how well the public knows state-level COVID-19 policies, and how mask-wearing and social-distancing behavior are predicted by actual and perceived policies. We found that most of the public know that their state has a mask mandate if their state indeed has one, but about half of them think their state has a mask mandate if their state does not have one. Awareness of business reopening policies was almost nonexistent, with no correlation between perceived reopening level and actual business reopening level per state policy. Granted, a small number of businesses may not abide by state policy perfectly, leading to a different reality of actual business opening levels compared to the policy, which could impact the public's perceptions. However, it is very unlikely that this rare disobedience of state laws could explain the total lack of correlation between perceived business opening levels and actual business opening policy. Mask-wearing and social distancing showed positive correlations, consistent with recent evidence [13]. Thus, these two preventive behaviors are not used as substitutes for each other.

Most importantly, despite a positive bivariate correlation between actual mask mandate and mask wearing behavior, when all control variables are accounted for it is the perception of a mask mandate, rather than an actual mask mandate, that was a significant correlate for both mask-wearing and social distancing—two of the most critical individual behaviors to prevent COVID-19 spread. In fact, perceived mask mandate was the biggest correlate for mask-wearing behaviors only after political orientation, age, and state level total cases per million. State reopening policy did not have a clear-cut influence on behavior, and this could be due to a lack

of a clear link between state-level business reopening policies and what the state is directing their residents to do in their individual behaviors such as mask-wearing and social-distancing. One interesting finding is the relatively large effect of participant's numeracy relative to other control variables on social-distancing behavior, which suggests an important role of numerical skills in interpreting COVID-19 related health information, and in turn, influencing this critical preventive behavior.

These findings have important implications. First, we cannot assume that the public's beliefs about their state's COVID-19 related policies are well aligned with the actual policies in place. Perceptions of mask mandate policy tend to err on the side of assuming a mask mandate when there is none, and perceptions of business opening levels are almost completely inaccurate. Second, policy perceptions are consequential in predicting behaviors. In fact, what the public believes to be their state's mask-mandate policy is a superior correlate for their COVID-19 preventive behaviors compared to the actual mask mandate policy. This means that promoting mask use and social distancing requires not just mask mandate policies, but more importantly, making sure that the public believes that a mask mandate exists. Interestingly, because the public tends to think there is a mask mandate even if there is none, public health messages that gave rise to this perception may be effective enough to promote preventive COVID-19 behavior regardless of actual mask-mandate policy. On the other hand, the total lack of relationship between perceived and actual state policies on business opening suggests that much more work needs to be done to get the message on business restrictions through to the public. In summary, given that mask use and social distancing are the two most critical behavioral tools in controlling the COVID-19 pandemic, we argue that greater public health resources should be applied to

informing public beliefs about the existence of COVID-19 related policies, beyond establishing these policies per se.

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Table 1. Predictors for mask-wearing and social-distancing in two separate regressions [a].

	Mask-wearing			Social-distancing		
	B	*p*	*sp* η^2	*B*	*p*	*sp* η^2
Perceived mask mandate	0.330	.001	.010	0.194	.023	.005
Actual mask mandate	0.103	.274	.001	-0.038	.639	<.001
Perceived reopening level	-0.067	.147	.002	0.078	.049	.003
Actual reopening level [b]	1.341	.008	.006	0.521	.224	.001
Total cases/1M[c]	2.8×10^{-5}	.001	.010	-1.2×10^{-6}	.868	<.001
New cases/ 1M[d]	0.001	.009	.006	0.001	.039	.004
Female	0.005	.944	<.001	0.168	.009	.006
Age	0.011	<.001	.018	0.018	<.001	.064
Education level	0.050	.113	.002	0.007	.805	<.001
Household income	-0.004	.798	<.001	0.02	.185	.002
Political orientation	0.201	<.001	.038	0.132	<.001	.023
Race/Ethnicity	0.221	.116	.002	0.042	.724	<.001
Hispanic						
African American	0.308	.006	.007	0.022	.820	<.001
Asian	0.419	.042	.004	0.036	.837	<.001
Native or multiracial	0.387	.142	.002	0.092	.684	<.001
Numeracy	0.035	.358	.001	0.127	<.001	.014
Know someone w/COVID-19[e]	0.020	.813	<.001	0.033	.641	<.001
Had COVID-19	-0.141	.450	<.001	-0.395	.013	.005
Model R^2		.14			.14	

a. Complete results from all models of the hierarchical regressions are presented in Electronic Supplementary Table S1 & Table S2. Note that the pre-registration planned to include an additional predictor "perceived effectiveness of face masks/social-distancing". We did not present results when perceived effectiveness of face masks/social-distancing are included in the regressions, because perceived effectiveness is theoretically more proximal to mask-wearing and social distancing behaviors than other predictors, and can act as a potential mediator for the effect of other predictors on behaviors.

b. Coded based on publicly available record on reopening policies regarding the 7 general categories of businesses in each state listed by the New York Times on Friday, July 17, 2020 [3].

c. Based on state total case data by July 18, 2020, the Saturday before the study[9].

d. Based on average daily cases the week of July 13-19, 2020, the week before the study[10].

e. There were 309 participants (28%) in our sample who knew someone with COVID-19.